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DRYLAND PASTURE AND CROP CONDITIONS AS SEEN BY HCMM

Progress Report for Period
July - October 1979

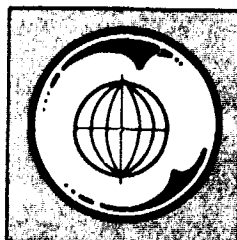
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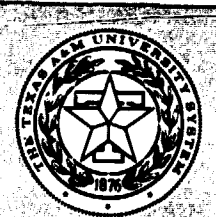
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Greenbelt, Maryland 20771

Contract NAS5-24383



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DRYLAND PASTURE AND CROP CONDITIONS
AS SEEN BY HCMM

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1.0 BACKGROUND AND SUMMARY

1.1 Background

This 32-month project is an extension of several other projects which involve estimates of wheat yield (Harlan et al., 1978), green biomass (Deering et al., 1977) and watershed run-off coefficient (Blanchard, 1978) using visible, near infrared and passive microwave data. In each estimate, soil moisture content is a major determining factor. The hypothesis of this study is that high resolution thermal infrared data, such as those received from HCMM, will enhance estimates of soil moisture content. Therefore, the three objectives of this project, as given in the statement of contract NAS5-24383, are:

- 1) to assess the capability for determining wheat and pasture canopy temperatures in a dryland farming region from HCMM data.

- 2) to assess the capability for determining soil moisture from HCMM data in dryland crops (winter wheat) from adjacent range lands.

- 3) to determine the relationship of HCMM-derived soil moisture and canopy temperature values with the condition of winter wheat and dryland farming areas during the principal growth stages.

To accomplish these objectives, measurements will be obtained at three levels: ground truth, aircraft, and satellite. The sites selected for these measurements are on the

Washita River watershed, near Chickasha, Oklahoma. The area has a dense USDA/SEA-AR network of rain gauges, and range-land and dryland winter wheat are often adjacent to each other. Ground truth data include canopy and lake surface temperatures, neutron probe and gravimetric soil moisture samples, and daily precipitation data. The aircraft collected day/night thermal scanner data and aerial photos of commercial wheat and pasture fields; HCMM has collected day/night thermal imagery over the same sites. Data collected from each level will be correlated in three ways:

- 1) thermal (HCMM and aircraft) parameters of soil moisture and crop canopy temperatures will be derived,
- 2) a technique will be developed to calculate the antecedent precipitation indices from the thermal parameters of soil moisture and canopy temperatures, and
- 3) an input parameter for yield prediction models will be developed.

1.2 Summary

Accomplishments during the seventh period of the contract (July-October 1979) include

- 1) presentation of a paper dealing with the relationship between soil moisture parameters and thermal infrared data at the annual Agronomy Society of America (ASA) meetings in Ft. Collins, Colorado, and
- 2) arrival of HCMM tapes and images of Chickasha, Oklahoma, and Colby, Kansas.

A copy of the abstract of the paper presented at the ASA meetings is included as Appendix A.

Ten CCT's which include data over the Oklahoma sites have arrived from NASA/^{GSFC}~~JSC~~. Unfortunately, no 12 hour day/night combinations are included in this group. Sevety-five images of the Kansas and Oklahoma sites were received. Of those received over the Oklahoma site, only 3 dates can be considered as day/night passes. The Kansas sites have not been fully analyzed yet.

2.0 ACCOMPLISHMENTS AND PROBLEMS

2.1 Accomplishments

During the seventh period, a paper was presented at the annual ASA meetings on the relationship between soil moisture parameters and thermal infrared data. The results are from the data set collected in May 1978 at Chickasha, Oklahoma. A copy of the abstract is presented in Appendix A.

Ten HCMM tapes with data over the Oklahoma site, and many images over the Kansas and Oklahoma site have been received during this period. No day/night tapes over the Oklahoma sites were received; however, at least three day/night combinations have been detected using the HCMM images. These tapes will be ordered from NASA.

2.2 Future Accomplishments

During the next period, we will begin to analyze the thermal digital data from the CCT's in relation to the precipitation data, which will arrive during the next period. Greymaps of the Chickasha area will be produced at a scale of 1:250,000. These maps can then be overlaid onto a topographic map where pasture and wheat fields have been located. Temperatures for these fields can then be easily determined.

Additional tapes of day/night passes over the Chickasha area will be ordered. Images of the Kansas site will also be analyzed as possible additional day/night data sets. These passes will also be ordered.

2.3 Problems

The only problem, as briefly described earlier, has been determining an adequate number of day/night passes over the Chickasha site. Of the images received, only 3 clear day/night passes were obtained over the site. More images of the area are needed to determine additional clear day/night passes. If additional clear passes are not detectable, clear day/night passes over the alternate site, Colby, Kansas, will be ordered.

3.0 SIGNIFICANT RESULTS

No significant results were obtained during this period.

4.0 FUNDS EXPENDED

Table 1 shows the funds expended during the first seven quarters. The funding extension has brought the total budget during the 32-month project to \$87,090. The total amount used in the seventh period is \$9,216. The total amount used through the seven periods is \$61,036, or 70% of the total budget. During the next period, the majority of funds will be allotted to salaries and computer processing costs.

TABLE 1. FUNDS EXPENDED

	FIRST FOUR QUARTERS	FIFTH QUARTER	SIXTH QUARTER	SEVENTH QUARTER
Supplies	\$ 537	\$ 40	\$115	\$ 0
Travel	3,224	0	0	268
Other Direct Costs	<u>9,600</u>	<u>1,724</u>	<u>385</u>	<u>175</u>
Total Other Direct Costs	13,361	1,764	505	443
Salaries & Wages	19,083	5,913	0	5,967
Total Indirect	<u>8,668</u>	<u>2,626</u>	<u>0</u>	<u>2,806</u>
TOTAL FUNDS EXPENDED	\$41,012	\$10,303	\$505	\$9,216

5.0 AIRCRAFT AND SATELLITE DATA USAGE

The HCMM images are reasonably good quality. Some thermal IR images have excellent detail, while others are poor.

The HCMM CCT's were received and analyzed by locating the Chickasha area on the digital color display. Once located, greymaps of the area were produced at a scale of 1:250,000. The digital data appears to be very good, showing sharp contrast.

APPENDIX A

The objective of this study was to relate day/night surface temperature differences to soil moisture parameters (volumetric soil moisture content, and antecedent precipitation index) in wheat and pasture fields. Three data sets were collected at 16 commercial dryland wheat and pasture fields at Chickasha, Oklahoma, in May, 1978: (1) thermal infrared data by the thermal channel of NASA's M²S (modular multiband scanner), (2) gravimetric soil moisture data (0-45 cm) at representative sites in each field, and (3) precipitation data along the flight lines during the previous month. Each data set was compared. A qualitative relationship was determined between day/night surface temperature differences and different levels of soil moisture.